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ABSTRACT

A study described, analyzed, and interpreted the ways an effective high school teacher used literacy activities (reading, writing, and discussion) to teach chemistry to first-year chemistry students. The teacher selected was considered effective by peers and students and professed to intentionally use literacy activities as a means of teaching content. The teacher taught in a rural, midwestern high school located outside a mid-size university town. Field notes from classroom observations were informed by teacher interviews, as well as interviews with key student informants. Results indicated that: (1) literacy activities both depended on and fostered students' abilities to organize materials, concepts, and thinking about chemistry; and (2) the atmosphere of organization and active involvement was developed through the teacher's use of multiple literacy activities. Findings suggest that effective teachers choose instructional activities that foster direct student involvement, and that effective teachers develop teaching strategies that best suit their individual classroom contexts. (Seventeen references are attached.) (RS)

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Literacy in the Chemistry Classroom:

An Ethnographic Study of Effective Teaching

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Paper presented at the 42nd Annual Meeting of the

National Reading Conference

San Antonio, TX

December, 1992

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Literacy in the Chemistry Classroom: An Ethnographic Study of Effective Teaching

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The purpose of this study was to describe, analyze, and interpret the ways an effective high school teacher used literacy activities (reading, writing, and discussion) to teach chemistry to first-year chemistry students. The area of chemistry was chosen because the literacy demands in this content are especially challenging for young people (Santa, Havens, & Harrison, 1989).

The study of effective teachers' use of literacy activities to teach content holds great promise. The potential for reform in education as a result of studying effective teachers has been recognized in research literature (Barr, 1986; Berliner, 1986), but researchers have not concentrated their efforts in this area. Dillon's (1989) microethnography of an effective secondary teacher supports the need for further research in the area of effective teaching: "Careful scrutiny of how and why effective teachers facilitate classroom lessons will enable present and prospective teachers to identify and reflect upon their own actions as teachers in various contexts" (p. 257).

Furthermore, there is a demand for improved literacy skills among secondary school students and graduates. This demand, as well as the evidence that relatively few secondary teachers incorporate literacy strategies into their teaching of specialized

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subjects (Ratekin, Simpson, Alvermann, & Dishner, 1985; Readence, Konopak, & Wilson, 1991), provides impetus for further study. Hence, we need continued, improved research on the teaching of literacy in various subject areas at the middle and secondary school levels. To achieve this understanding, the perspectives and ongoing practice of effective teachers who use literacy strategies must be examined (Alvermann & Moore, 1990). Qualitative research is a methodology that allows researchers to gain insight into the complex processes of teaching learning literacy in specialized fields as outlined above.

Research questions guiding this study focused on:

1) the nature of the literacy events used in the classroom,
2) how often the classroom participants were involved in various literacy activities, and
3) how students and teacher perceived the use of literacy activities in the classroom.

Method

Methodology & Theoretical Framework

The methodology of ethnography framed both the research questions and the methods chosen in this study. Erickson (1984) has supported the use of ethnography to investigate classroom practice, stating that the unit of analysis for the ethnographer consists of "any social network forming a corporate entity in which social relations are regulated by custom" (p. 52). In addition, the theoretical framework of holistic ethnography, which attempts to describe and analyze the beliefs and practices of a

group within a culture and explain how this group's activity contributes to the culture as a whole (Jacob, 1987), guided this study.

Selection of Site and Participant

The teacher and her chemistry classroom were chosen in a purposive manner (Patton, 1990). Because the focus of the study was on the relationship between effective teaching and literacy activities, it was necessary to select a participant who was considered effective by peers and students and who professed to intentionally use literacy activities as a means of teaching content. The selected teacher taught in a rural, midwestern high school located outside a mid-size university town. The study was conducted over a seven-month period in a first-year chemistry class, held from 8:25-9:15. The teacher's main objective in her chemistry teaching was the development of scientific literacy skills among her students. The teacher's definition of scientific literacy revolved around aspects of critical reading and thinking, oral and written communication skills, and the development of questioning abilities. Her definition of literacy activities included any event that involved reading, writing, or discussion [Interview; 10-03-91].

Researcher Role

Following the framework of holistic ethnography, I assumed a participant-observer role. The participant aspect of this role consisted primarily of working and talking with students during small group, laboratory, and computer work, whereas the observer aspect consisted of collecting fieldnote data during whole class discussions.

Literacy in the Chemistry Classroom, Moje, 1992

My background in science teaching and content literacy methods contributed to the analysis and interpretation of events in this classroom.

Data Sources

Fieldnotes from observations were informed by teacher interviews, as well as interviews with key student informants. Key informants were selected purposefully, based on their interactions with the teacher, their participation in various literacy activities, and their willingness to talk to me. Informal "interviews" before and after class were recorded as fieldnotes. Secondary data consisted of video and audiotaped lesson transcriptions, photographs of setting and participants, and written documents such as lesson plans, hand-outs, student notes, laboratory exercises, and study guides.

Data Analysis

Data analysis was based on the constant comparative method (Glaser & Strauss, 1967), a method which consisted of daily analyses and comparison of field notes, transcripts, and interviews to determine emerging patterns and categories. These categories guided future data collection and focused collection on events that would help answer new questions. This method of analysis also provided the means by which emergent patterns could be confirmed or negated (Erickson, 1986). Analysis was aided by the construction of theoretical memos (Strauss, 1990) and key linkage charts (Erickson, 1986).

Results & Discussion

This teacher enacted her goal of scientific literacy by meshing literacy activities with her teaching of chemistry concepts. The teacher's goal of scientific literacy and her philosophical belief that "science is organization" [Interview; 10-24-91], influenced her instructional decisions, particularly her choice of literacy activities. The students, however, interpreted her use of literacy activities in terms of her concern or "caring" for them because the activities were designed to help them become better chemistry learners. For example, student interview comments included:

> "I like Ms. L. as a teacher. She takes time and waits until everyone understands. She cares about students." [Student interview; 10-22-91]
>
> "Ms. L. makes sure, you know, everyone is involved in class . . . if she sees someone doesn't understand, she like, picks up on it. . . ." [Student interview; 03-02-92]
>
> "She's organized. She tells us how to take notes and which section of our notebook to put things in. . . . it's easier to go through stuff that's in order for the test." [Student interview; 11-12-91]

The teacher's concern for students was demonstrated by her attitude toward students as learners. Instead of reaching out to students by asking about personal activities, the teacher reached out to them as chemistry students to bring them into membership in the scientific community.

In an attempt to show the connection between the use of literacy activities and the students' perception of her concern for them, and thus, her effective teaching, the

following assertions were generated. First, in this classroom, ***literacy activities both depended on and fostered students' abilities to organize materials, concepts, and thinking about chemistry***. Organization was the thread which intricately wove literacy and chemistry learning together and was used by the teacher to develop independent thinking, reasoning, and learning skills. Such organization was developed through multiple literacy activities, which included reading, discussion, and problem-solving. Two categories were generated from the data that illustrate the uses and types of literacy activities and that illustrate the central nature of organization: (a) literacy as a ***foundation*** for organization, and (b) literacy as a ***facilitator*** for organization in learning and thinking about chemistry (Moje, 1991).

Second, as a result, the students in this classroom considered the teacher effective because she ran an organized classroom and required organization from them. They also considered the teacher effective because she required their involvement in class activities. ***The atmosphere of organization and active involvement was developed through the teacher's use of multiple literacy activities***. The teacher was considered effective by peers, students, and parents because she constructed a classroom based on organization in thinking, acting, and learning. Students were taught strategies for organizing their thinking and learning and felt confident that the teacher would maintain organization in her teaching of content. In addition, however, the students were actively involved in lessons, and felt a responsibility for their own learning. The atmosphere of organization and active

involvement was developed through the use of literacy activities. Thus, the students interpreted the literacy activities that the teacher considered foundation builders as ***organizers***. Those activities that the teacher used to facilitate learning and thinking the students considered to be activities that helped keep them ***involved*** in chemistry learning.

Fieldnotes from classroom observations and interview data revealed the teacher's belief that literacy activities promoted student organization of concepts, learning from text, and independent thinking and studying, thus providing foundations and facilitators for chemistry learning. For example, when asked why she used a reading and study strategy called SQ3R (Survey, Question, Read, Recite Review - Robinson, 1941), the teacher explained:

> "The kids learn to do [SQ3R] to help them read their books. Then we don't spend time on picking the book apart in class. Everything we do in class can be an extension or illustration of the book's concepts because the students are prepared by reading and taking notes on their own." [Interview; 10-03-91]

This excerpt illustrates the way literacy activities were used both to provide a knowledge base (foundation) and as learning and study strategies (facilitators). The teacher, who like many content teachers felt pressure to cover a great deal of concepts, saw this literacy strategy as a way students could prepare new course material independently. At the same time, the teacher recognized the students' development as learners, and provided a sort of scaffolding device (Wood, Bruner, & Ross, 1976) that would facilitate their learning of new material.

Fieldnotes and student interview comments also illustrated how students believed that the use of the various literacy activities helped them maintain organization and active involvement in class. When asked about the importance of reading material before class, one student responded:

> " . . . You need to read it so you have, you know what's going on in class. 'Cause if you don't read the assignment, you get there and you have no clue about what's happening. but if you read the assignment, then you know everything in class, all the questions she asks." [Interview; 03-02-92]

This excerpt illustrates how students perceived the teacher's use of literacy activities as a way of helping them be organized--knowing everything in class--and as a way of keeping them involved. Because they were able to know what was happening and answer questions, the students felt as if they could maintain an active, organized involvement.

Conclusions & Implications

Just as this teacher demonstrated her concern and respect for her students as learners, the students in her class verbalized their respect for the teacher as teacher. In other words, to the students, the teacher's effectiveness stemmed more from her ability to organize and involve the class in learning chemistry concepts, than from an engaging personality or unusual wit. One of the ways Landy organized and involved students was through the use of literacy activities. Her use of literacy activities to build a foundation of knowledge and to facilitate thinking and studying was interpreted by the students as her way of organizing their activities and keeping them involved.

To the students, these strategies contributed to the teacher's effectiveness and demonstrated her concern for them as learners.

The results of this study are important to both the study of effective teaching and content literacy teaching and research for several reasons. First, the results of this study support research on effective teaching which states that effective teachers choose instructional activities that foster direct student involvement (Conley & Murphy, 1987). In addition, these results support Conley & Murphy's (1987) assertion that effective teachers "offer students a clear sense of what is expected (foundation/organization) and structure activities to sustain interest and increase opportunities to learn (facilitator/involvement)" (p. 22-23). In this setting, both teacher and students acknowledge the importance of organization and involvement.

These findings also shed light on the complex process of effective teaching for secondary teachers. The results support Dillon's (1989) assertion that teachers are not necessarily considered effective because they display a set of behaviors deemed effective by research. Rather, effective teachers develop teaching strategies that best suit their individual classroom contexts (Duffy, 1992). The teacher in this study was considered effective by students because she communicated in an organized manner and actively involved them, in part by using literacy activities. Such a finding illustrates the complex relationship between the use of literacy activities and teacher and student perceptions of why and how those activities contribute to effectiveness. Moreover, the use of literacy activities represents only one element of the teacher's

effective instructional patterns, further highlighting the intricacies of effective classroom instruction. In addition, whereas Dillon's study portrayed an effective teacher as one who demonstrated his concern for students based on their cultural and personal backgrounds (1989), this study illustrated a different pattern for effective teaching. In this classroom, the teacher showed her concern for students as learners, first. Comparing the results of these two studies underscores the complexity involved in understanding effective teaching and learning.

Finally, the study of the connections between effective teaching and the use of literacy activities leads to implications for teaching and research in content literacy. First, rather than merely teaching about the efficacy of various content literacy strategies, content literacy educators should guide pre- and inservice teachers in discussions about the nature of effective teaching and learning in their disciplines, with a focus on evaluating their own philosophical beliefs about their disciplines and the ways those beliefs shape instructional decisions. In addition, content literacy educators should engage pre- and inservice teachers in discussions of what secondary students perceive to be effective teaching, in comparison to what teachers' and researchers' notions of effectiveness entail.

Second, research in content literacy strategies and practices must focus more on classroom interactions, with the goal of understanding how and why teachers use and modify literacy strategies to fit their students' needs (Alvermann & Moore, 1991; Dillon, 1989). Content literacy research should also strive to understand student

perceptions of the use and importance of literacy in various content areas, with a focus on the meanings students and teachers make as they engage in literacy events.

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